DRAFT

Omics Research on the International Space Station

The International Space Station (ISS) is an orbiting laboratory whose goals include advancing science and technology research. Completion of ISS assembly ushered a new era focused on utilization, encompassing multiple disciplines such as Biology and Biotechnology, Physical Sciences, Technology Development and Demonstration, Human Research, Earth and Space Sciences, and Educational Activities. The research complement planned for upcoming ISS Expeditions 45&46 includes several investigations in the new field of omics, which aims to collectively characterize sets of biomolecules (e.g., genomic, epigenomic, transcriptomic, proteomic, and metabolomic products) that translate into organismic structure and function. For example, Multi-Omics is a JAXA investigation that analyzes human microbial metabolic cross-talk in the space ecosystem by evaluating data from immune dysregulation biomarkers, metabolic profiles, and microbiota composition. The NASA OsteoOmics investigation studies gravitational regulation of osteoblast genomics and metabolism. Tissue Regeneration uses pan-omics approaches with cells cultured in bioreactors to characterize factors involved in mammalian bone tissue regeneration in microgravity. Rodent Research-3 includes an experiment that implements pan-omics to evaluate therapeutically significant molecular circuits, markers, and biomaterials associated with microgravity wound healing and tissue regeneration in bone defective rodents. The JAXA Mouse Epigenetics investigation examines molecular alterations in organ specific gene expression patterns and epigenetic modifications, and analyzes murine germ cell development during long term spaceflight. Lastly, Twins Study ("Differential effects of homozygous twin astronauts associated with differences in exposure to spaceflight factors"), NASA's first foray into human omics research, applies integrated analyses to assess biomolecular responses to physical, physiological, and environmental stressors associated with spaceflight.